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(तीसरा पुनरीक्षण)

Indian Standard

METHOD FOR VERIFICATION OF VICKERS HARDNESS TESTING MACHINES

(Third Revision)

ICS 77.040.10

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

September 2002 Price Group 5

Mechanical Testing of Metals Sectional Committee, MTD 3

NATIONAL FOREWORD

This Indian Standard (Third Revision) which is identical with ISO 6507-2:1997 'Metallic materials — Vickers hardness test — Part 2: Verification of testing machines' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Mechanical Testing of Metals Sectional Committee and approval of the Metallurgical Engineering Division Council.

The earlier Indian Standard on 'Method for verification Vickers hardness testing machines' was covered by the following two parts:

IS 1754 (Part 1) : 1986	Method for verification of Vickers hardness testing machines: Part 1 HV 0.2 to HV 100 (*second revision*)
IS 1754 (Part 2) : 1986	Method for verification of Vickers hardness testing machines: Part 2 Less than HV 0.2 (*second revision*)

This revision of the standard has been prepared by merging the above two parts and to align it with ISO 6507-2 : 1997 by adoption under dual numbering system.

In this adopted standard, certain terminology and conventions are, however, not identical to those used in Indian Standards. Attention is especially drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to the following International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 376	IS 4169 : 1988 Method for calibration of force-proving instruments used for the verification equivalent of uniaxial testing machines (*first revision*)	Technically equivalent
ISO 3878 : 1983	IS 12783 : 1989 Hardmetals — Vickers hardness test	do
ISO 6507-1 : 1997	IS 1501 : 2002 Method for Vickers hardness test for metallic materials (*third revision*)	Identical
ISO 6507-3 : 1997	IS 4133 : 2002 Method for calibration of standardized blocks to be used for Vickers hardness testing machines (*second revision*)	do

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

METHOD FOR VERIFICATION OF VICKERS HARDNESS TESTING MACHINES

(Third Revision)

1 Scope

This part of ISO 6507 specifies a method of verification of testing machines for determining Vickers hardness in accordance with ISO 6507-1.

It describes a direct verification method for checking the main functions of the machine, and an indirect verification method suitable for the overall checking of the machine. The indirect verification method may be used on its own for periodic routine checking of the machine in service.

If a testing machine is also to be used for other methods of hardness testing, it is essential that it is verified independently for each method.

Portable hardness testing machines shall comply with all the requirements of this part of ISO 6507, but the word "relocation" in 6.1a) does not apply.

The force values in this part of ISO 6507 were calculated from kilogram force values. They were introduced before the SI-system was adopted. It was decided to keep the values based on the old units for this edition, but for the next revision it will be necessary to consider the advantage of introducing rounded values of test force and the consequence on the hardness scales.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6507. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6507 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 376:—[1], *Metallic materials — Calibration of force-proving instruments used for the verification of uniaxial testing machines.*

ISO 3878:1983, *Hardmetals — Vickers hardness test.*

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method.*

ISO 6507-3:1997, *Metallic materials — Vickers hardness test — Part 3: Calibration of reference blocks.*

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[1] To be published. (Revision of ISO 376:1987)

3 General conditions

Before a Vickers hardness testing machine is verified, it shall be checked to ensure that

a) the machine is properly set up;
b) the plunger holding the indenter is capable of sliding in its guide;
c) the indenter-holder is firmly mounted in the plunger;
d) the test force can be applied and removed without shock or vibration and in such a manner that the readings are not influenced;
e) if the measuring device is integral with the machine
    1) the change from removing the test force to measuring mode does not influence the readings,
    2) illumination does not affect the readings,
    3) the centre of the indentation is in the centre of the field of view, if necessary.

The illumination device of the measuring microscope shall produce uniform lighting of the whole observed field and maximum contrast between the indentation and the surrounding surface.

4 Direct verification

Direct verification should be carried out at a temperature of (23 ± 5) °C. If the verification is made outside this temperature range, this shall be reported in the verification report.

The instruments used for verification shall have a certified traceability using the International System of Units (SI).

Direct verification involves

a) verification of the test force;
b) verification of the indenter;
c) verification of the measuring device;
d) verification of the testing cycle.

4.1 Verification of the test force

4.1.1 Each test force used within the working range of the testing machine shall be measured. Whenever applicable, this shall be done at not less than three positions of the plunger uniformly spaced throughout its range of movement during testing.

4.1.2 The test force shall be measured by one of the following two methods:

a) by means of an elastic proving device in accordance with ISO 376, class 1,

b) by balancing against a force, accurate to ± 0,2 %, applied by means of standardized masses with mechanical advantage.

4.1.3 Three readings shall be taken for each test force at each position of the plunger. Immediately before each reading is taken, the plunger shall have been moved in the same direction as during testing.

4.1.4 Each measurement for the force shall be within the tolerances of the nominal value of the test force, as given in table 1.

Table 1

Ranges of test force, *F* N	Tolerances %
$F \geqslant 1{,}961$	± 1,0
$0{,}098\,07 \leqslant F < 1{,}961$	± 1,5

4.2 Verification of the indenter

4.2.1 The four faces of the square-based diamond pyramid shall be polished and free from surface defects.

4.2.2 The verification of the shape of the indenter can be made by direct measurement or by measurement of its projection on a screen.

4.2.3 The angle between the opposite faces at the vertex of the diamond pyramid shall be 136° ± 0,5° (see figure 1).

4.2.4 The angle between the axis of the diamond pyramid and the axis of the indenter-holder (normal to the seating surface) shall be less than 0,5°. The four faces shall meet in a point; the maximum permissible length of the line of conjunction between opposite faces is given in table 2 (see also figure 2).

Independent of the intervals between the direct verifications of the testing machines, the indenter shall be verified at intervals not exceeding two years.

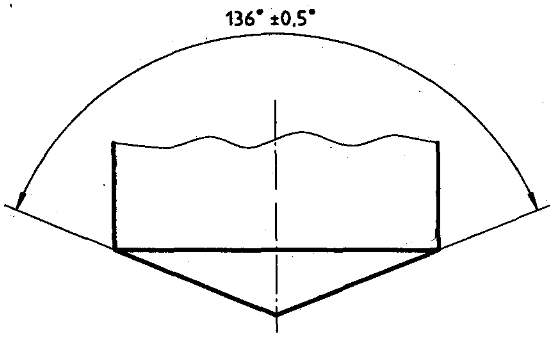
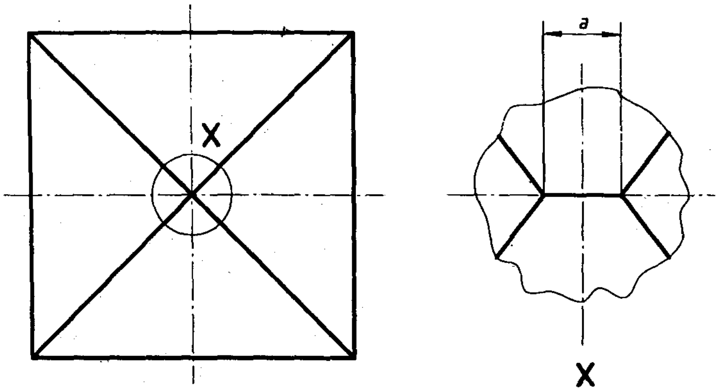


Figure 1 — Angle of the diamond pyramid



a = length of line of conjunction

Figure 2 — Line of junction on the top of the indenter (schematic)

Table 2

Ranges of test force, *F* N	**Maximum permissible length of the line of conjunction, *a*** mm
$F \geqslant 49{,}03$	0,002
$1{,}961 \leqslant F < 49{,}03$	0,001
$0{,}098\,07 \leqslant F < 1{,}961$	0,000 5

4.3 Verification of the measuring device

4.3.1 The estimation capability required of the measuring device depends on the size of the smallest indentation to be measured.

The scale of the measuring device shall be graduated to permit estimation of the diagonals of the indentation in accordance with table 3.

Table 3

Diagonal length, *d* mm	**Estimation capability of the measuring device**	**Maximum permissible error**
$d \leqslant 0{,}040$	0,000 2 mm	0,000 4 mm
$d > 0{,}040$	0,5 % of *d*	1,0 % of *d*

The estimation capability of the measuring device for Vickers hardness testing of hardmetals is specified in ISO 3878.

4.3.2 The measuring device shall be verified by measurements made on a stage micrometer at a minimum of five intervals over each working range.

The maximum permissible error shall not exceed the values given in table 3.

4.3.3 In addition to this direct verification, an indirect verification of the measuring device may be carried out in accordance with the procedure described in annex A.

4.4 Verification of the testing cycle

The testing cycle shall be timed with a tolerance of 1 s and shall conform to the testing cycle of ISO 6507-1.

5 Indirect verification

Indirect verification should be carried out at a temperature of (23 ± 5) °C by means of reference blocks calibrated in accordance with ISO 6507-3. If the verification is made outside this temperature range, this shall be reported in the verification report.

5.1 When verifying testing machines which use several test forces, at least two forces shall be chosen. One of the forces shall be the test force most frequently used. For each test force chosen, two different reference blocks shall be selected from the different hardness ranges specified below. The forces and blocks shall be chosen so that at least one reference block in each hardness range shall be used for the verification.

$\leqslant$ 225 HV
400 HV to 600 HV
$>$ 700 HV

5.2 When verifying testing machines using only one test force, three reference blocks shall be used, one in each of the ranges specified in 5.1.

5.3 For special purposes, a hardness testing machine may be verified at one hardness value only, corresponding approximately to that of the tests to be made.

5.4 On each reference block, five indentations shall be made and measured. The test shall be made in accordance with ISO 6507-1.

5.5 For each reference block, let d_1, d_2, ..., d_5, be the arithmetic mean values of the measured length of the two diagonals of the indentations, arranged in increasing order of magnitude.

5.6 The repeatability of the testing machine under the particular verification conditions is determined by the difference

$$d_5 - d_1$$

The repeatability of the testing machine verified is not considered satisfactory unless it satisfies the conditions given in table 4.

Table 4

Hardness of the reference block	Repeatability of the testing machine max.						
	$\overline{d}$ 1)			HV			
	HV 5 to HV 100	HV 0,2 to < HV 5	< HV 0,2	HV 5 to HV 100		HV 0,2 to < HV 5	
				Hardness of the reference block	HV	**Hardness of the reference block**	HV
≤ 225 HV	0,03 $\overline{d}$	0,06 $\overline{d}$	0,06 $\overline{d}$	100 200	6 12	100 200	12 24
> 225 HV	0,02 $\overline{d}$	0,04 $\overline{d}$	0,05 $\overline{d}$	250 350 600 750	10 14 24 30	250 350 600 750	20 28 48 60

1) $\overline{d} = \frac{d_1 + d_2 + ... + d_5}{5}$

5.7 The error of the testing machine under the particular verification conditions is characterized by the difference:

$$\overline{H} - H$$

where

$$\overline{H} = \frac{H_1 + H_2 + ... + H_5}{5}$$

where

$H_1, H_2, ..., H_5$ are the hardness values corresponding to $d_1, d_2, ..., d_5$;

H is the specified hardness of the reference block used.

The maximum error of the testing machine, expressed as a percentage of the specified hardness of the reference block, shall not exceed the values given in table 5.

Table 5

Hardness symbol	Maximum permissible percentage error of the hardness testing machine															
	Hardness, HV															
	50	100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1500
HV 0,01																
HV 0,015	10															
HV 0,02	8															
HV 0,025	8	10														
HV 0,05	6	8	9	10												
HV 0,1	5	6	7	8	8	9	10	10	11							
HV 0,2		4		6		8		9		10	11	11	12	12		
HV 0,3		4		5		6		7		8	9	10	10	11	11	
HV 0,5		3		5		5		6		6	7	7	8	8	9	11
HV 1		3		4		4		4		5	5	5	6	6	6	8
HV 2		3		3		3		4		4	4	4	4	5	5	6
HV 3		3		3		3		3		3	4	4	4	4	4	5
HV 5		3		3		3		3		3	3	3	3	3	4	4
HV 10		3		3		3		3		3	3	3	3	3	3	3
HV 20		3		3		3		3		3	3	3	3	3	3	3
HV 30		3		3		2		2		2	2	2	2	2	2	2
HV 50		3		3		2		2		2	2	2	2	2	2	2
HV 100				3		2		2		2	2	2	2	2	2	2

NOTES

1 Values are not given when the length of the indentation diagonal is less than 0,020 mm.

2 For intermediate values, the maximum permissible error may be obtained by interpolation.

3 The values for microhardness testing machines are based on a maximum permissible error of 0,001 mm or 2 % of the mean diagonal length of indentation, whichever is the greater.

6 Intervals between verifications

6.1 Direct verification

The direct verification shall be carried out

a) when the machine is installed or after its dismantling and reassembly or relocation;
b) when the result of the indirect verification is not satisfactory;
c) when indirect verification has not been made for a period greater than 12 months.

Each direct verification shall be followed by an indirect verification.

6.2 Indirect verification

The period between two indirect verifications depends on the maintenance standard and number of times the machine is used. In any case this period shall not exceed 12 months.

7 Verification report

The verification report shall include the following information:

a) reference to this part of ISO 6507;

b) method of verification (direct and/or indirect);

c) identification data of the hardness testing machine;

d) means of verification (reference blocks, elastic proving devices, etc);

e) test force;

f) verification temperature;

g) the result obtained;

h) date of verification and reference to the verification institution.

Annex A
(informative)

Example of a method for an indirect verification of the measuring device

Indirect verification of the measuring device may be carried out by measurements of the reference indentation on each reference block to be used for the indirect verification of the testing machine in accordance with 5.1 (see note to 8.3 in ISO 6507-3:1997).

The error of the measuring device, expressed as a percentage of the assigned length of the mean indentation diagonal of each reference indentation, shall be not more than 1 %.

Annex B
(informative)

Notes on diamond indenters

Experience has shown that a number of initially satisfactory indenters can become defective after use for a comparatively short time. This is due to small cracks, pits or other flaws in the surface. If such faults are detected in time, many indenters may be reclaimed by regrinding. If not, any small defects on the surface rapidly worsen and make the indenter useless.

Therefore,

— the condition of indenters should be monitored by visually checking the aspect of the indentation on a reference block, each day the testing machine is used;

— the verification of the indenter is no longer valid when the indenter shows defects;

— reground or otherwise repaired indenters shall be reverified.

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